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CONSERVATION TASKS AND CONCOMITANT VARIABLES

BY



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A THESIS

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "Conservation Tasks and Concomitant Variables" submitted by William W. Renner in partial fulfillment of the requirements for the degree of Master of Education.

ABSTRACT

This study examined the conservation concepts of substance, length and distance in the light of recent issues raised by Elkind (1967), Goldschmid, (1967), and Côté and Boersma (1969). The effects of concomitant variables such as age, sex, IQ and Socio-economic status (SES) were also considered. Five tests of symmetry, three tests of distance conservation, a compensation measure, two tests of substance conservation, and two tests of length conservation were administered to 96 grade one children. Their IQ rating was obtained from the school records and the Blishen Occupational Class Scale (1967) was employed as an SES rating. In order to ascertain whether the concomitant variables affected conservation task attainment Ss were divided into two groups on each of the following variables: age, sex, IQ, and SES. The relative success on each of the conservation tests by these groups was compared.

The most important findings of the study were as follows:

1. Identity of distance conservation is a necessary condition for equivalence of distance conservation.
2. The use of the more rigorous Côté-Boersma testing procedure diminished the incidence of Ss classified as being at Piaget et. al.'s (1960) questionable distance stage (Stage II, Sub-stage IIB, Type B).
3. Two stages of symmetry were identified.
4. The relative level of complexity of the conservation tasks in the



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present study were found to be in the following ascending order of complexity: substance, distance, and length.

5. Age, IQ, and SES were found to influence conservation attainment.
6. Sex was not found to influence conservation attainment.

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CHAPTER I

INTRODUCTION

A. OVERVIEW

In summarizing the contributions of Jean Piaget, Flavell (1963) points out that "One of the most important components of the transition from pre-operational to concrete-operational thought is the acquisition of various conservations (ibid., p. 245)." The present study is designed to investigate the relationship between a number of conservation concepts, which involve the cognition that certain properties of an object such as substance, quantity, length and time remain invariant in the face of transformations involving other properties of that object. Of primary concern will be various aspects of distance conservation; however, the concepts of symmetry, conservation of length and substance will also be investigated. Variables, such as differences of methodology as well as the factors of age, IQ, sex and socio-economic status (SES) and their interrelationship will also come under scrutiny.

The current literature reveals a relative sparsity of work dealing with conservation of distance. This is rather puzzling since a notion of distance is considered to be crucial to the emergence of relations which are essential to both the development of measurement and to the elaboration of co-ordinate systems (Piaget & Inhelder, 1956; Piaget, Inhelder & Szeminska, 1960).

The present study then, will be concerned with clarifying a number of issues raised by recent studies (Elkind, 1967; Goldschmid, 1967;

Côté-Boersma, 1969). Those issues are discussed in the second chapter.

B. LIMITATIONS

The establishment of a practical scope of inquiry dictated that the present study be limited to an investigation of recent issues raised by Elkind (1967), Goldschmid (1967), and Côté and Boersma (1969) regarding the development of conservation concepts of substance, length, and distance. A further limitation involves the fact that all Ss were selected from an urban first grade population.

C. DEFINITIONS

To delimit the parameters of some aspects of the present study the following operational definitions are advanced.

Conservation

The maintenance of a structure as invariant when undergoing certain physical changes provided nothing has been added or subtracted from the original amount or providing no one aspect of a reciprocal relationship has been unilaterally changed.

Equivalence Conservation

The type of conservation task in which the equality of a transformed variable is compared with a standard.

Identity Conservation

The type of conservation task in which the equality of a transformed variable is compared to its original state.

Distance

The linear separation between two objects (empty space).

Distance Conservation

1. The recognition that the distance relationship between two sites does not change when an object is interpolated between these two sites.
2. An operational understanding of the notion of symmetry.

Symmetry

The recognition that a distance AB is the same as the distance BA.

Length

Linear size (filled space).

Substance

Refers to continuous quantity, that is, coloured water.

Distance Conserver

A subject who exhibits an understanding of symmetry and also recognizes that a relationship between two objects does not change when another object is interpolated.

Older Group

Comprised of those subjects who are older than the mean of the total sample (mean 6.86 years, standard deviation .33 years).

Younger Group

Comprised of those subjects who are younger than the mean of the total sample.

High Socio-Economic Status Group (High SES Group)

Comprised of those subjects whose father's occupation ranks above the mean of the total sample (mean 58.45, standard deviation 17.88) as determined by the Blishen Occupational Class Scale (1967).

Low SES Group

Comprised of those subjects whose father's occupation ranks above the mean of the total sample as determined by the Blishen Occupational Class Scale (1967).

High IQ Group

Comprised of those subjects whose scores on the Detroit Beginning First-Grade Intelligence Test was above the mean of the total sample (mean 105.85, standard deviation 15.12).

Low IQ Group

Comprised of those subjects whose scores on the Detroit Beginning First-Grade Intelligence Test was below the mean of the total sample.

D. OUTLINE OF THE REPORT

The second chapter provides a review of the literature directly pertinent to the present study. In the third chapter the procedure to be employed is outlined. Specific postulates arising out of the pertinent research literature, from which the hypotheses were derived, are found in the fourth chapter. The fifth chapter is concerned with an analysis of the data obtained. The sixth and final chapter deals with a discussion of the results.

CHAPTER II

SOME RELATED LITERATURE

The typical Piagetian test for the conservation problem involves presenting the Ss with a standard (S) and a variable (V) stimulus which are initially equivalent both perceptually and quantitatively. Ss are then asked to make a judgement regarding their quantitative equivalence. Following their concession of quantitative equivalence, the variable stimulus is transformed from V to V^1 , in such a way that the perceptual but not the quantitative equivalence between the standard and the transformed variable is altered.

For example, in considering the classical problem of weight conservation (Piaget & Inhelder, 1962), Ss are presented with two clay balls (S and V) both equivalent in size, appearance and weight. Ss are then asked whether the clay balls are the same weight. Ss may test for this equivalence with the aid of scales. One of the balls, that is, the variable (V) is deformed into a pancake (V^1) or some other shape. Ss are then asked whether V^1 has more, less or the same weight as the standard clay ball (S). Responses attesting that the weight has not changed are taken as evidence of the presence of the conservation operation.

A possible variation of the classic method just mentioned allows the examiner to ascertain the presence of conservation in a slightly different manner. That is, rather than employing a standard, one could simply present a clay ball (V) to the Ss and then transform the same ball (V) into a pancake (V^1) and then inquire into their weight equality.

In an analysis of the conservation task, Elkind (1967) points out that the aforementioned procedure would be a measure of conservation of identity while the classical Piagetian method, which employs a standard is a measure of conservation of equivalence. Elkind (ibid.) also points out a possible contradiction in Piaget's theory in that "... Piaget's discussion is primarily aimed at explaining the conservation of identity and not the conservation of equivalence (ibid., p. 19)." However, equivalence is the only form of conservation assessed by the standard Piagetian conservation task. Elkind claims (ibid.) that conservation of identity is a necessary condition for the attainment of equivalence conservation which furthermore, requires "utilization of immediate past experience in the form of a deductive argument (ibid., p. 17)."

The acceptance of Elkind's contention appears to lead to the conclusion that some Ss who are not considered to have an operational notion of distance conservation on basis of Piagetian equivalence testing procedures, may indeed be classified as distance conservers when an identity conservation task is employed. Experimental evidence supporting this contention has not been available; nevertheless, Elkind concludes that "... conservation of identity appears earlier than conservation of equivalence (ibid., p. 23)."

Elkind's (ibid.) fine point of differentiation does not appear to have been of great concern to Piaget and his co-workers. Indeed, Piaget, while usually employing equivalence procedures does not always do so. An example of a Piagetian task which does not employ a standard and therefore disregards equivalence in favour of identity may be found in the procedures used to assess the presence of distance conservation. Piaget defines distance as linear separation (empty space) between

objects (Piaget, Inhelder, and Szeminska, 1960). The typical task presented to determine distance conservation, does not employ a standard and accordingly it would appear that rather than presenting a conservation of equivalence task, Piaget now presents a conservation of identity task. While this procedure may be more consistent with Piaget's theoretical formulations (Elkind, 1967 p. 23) it appears to be at odds with the procedures used by Piaget to determine the presence of other conservation concepts. A description of the technique employed by Piaget, et. al.(1960) should illustrate the point in question.

Piaget et. al. (1960) determine distance conservation by placing two identical objects, A and B on a table approximately 50 centimeters from one another. Ss are asked whether the objects are "near one another" or "far apart". This establishes the protocol to be followed in subsequent questioning of the Ss. Screens (Sc) of different thicknesses and heights are then placed between A and B. seemingly bisecting the distance A-B. Ss are then asked whether the objects are still as near (or as far apart) as they were originally. Ss affirming that A and B maintain their distance relationship in spite of the interpolated Sc are considered to be distance conservers. Symmetry of the distance A-B, free of interpolated elements is determined by asking Ss "Is it as far from there to there (indicating A to B) as it is from there to there (indicating B to A)?" This procedure is followed by placing objects of different sizes on the same horizontal plane, and also with either one or the other object raised 50 centimeters above its original site, so that objects A and B are now on different horizontal planes.

The distance conservation testing procedure employed in the present study reinserts the equivalence factor by making use of

equipment which makes it possible to present a visible standard for comparison. Pratoomraj and Johnson (1966), while simply employing three cube blocks, also conducted a unique study on distance conservation in which a visible standard was used. This fruitful direction of inquiry has apparently been abandoned. The present study used a new approach to test for equivalence rather than identity on the assumption that this method was more consistent with Piaget's testing procedures in other areas of conservation evaluation.

Côté and Boersma (1969) point out that in inserting a screen (Sc) between the two objects A and B, Piaget tends to place the Sc so that it seemingly bisects the spatial interval. Similarly Shantz and Smock (1966) describe their method of testing distance conservation as follows: "A board higher than the trees was placed halfway between them and the S was asked, 'And now, are they far apart (or near together)'?". Thus, examiners using the Piaget technique may accept as indications of responses the presence of conservation, such as: "Yes, the distance is the same because these two halves (indicating distance A-Sc and Sc-B) are the same. Responses such as the foregoing suggest that the S does not understand the task in question. That is, rather than considering the variance or invariance of the total distance A-B S interprets the question to be asking whether the two sub-distances created by the interpolation of the screen are the same. In the aforementioned sample answer, "Yes" would indicate the attainment of conservation and some examiners would be content to let it go at that. However, the justification given for the reply should make it clear that the "Yes" was the type of response which Smedslund (1963) refers to as being a "symptom response". This tendency on the part of the S to misinterpret the intent of the

question is magnified by Piaget's distance testing procedure.

The preceding observations are in keeping with Côté et. al.'s (1969) conclusion that the Piaget method for ascertaining the existence of distance conservation tends to accept responses indicative of conservation of distance where true conservation may not have existed in Ss. As a result of this kind of pseudo-conservation response Côté and Boersma (ibid.) modified the Piagetian technique so that the distances A-Sc and Sc-B were visibly not equal.

In order to derive clearer understanding of Côté and Boersma's (ibid.) findings it is desirable at this point to consider the three stages of distance conservation acquisition advanced by Piaget et. al. (1960). Those three stages are described in the following:

Stage I

Children do not bring together the two distances A-Sc, Sc-B. Thus the distance relationship between A and B does not have any meaning when the screen is interposed. At this stage distance is asymmetrical when A and B are on different horizontal planes and at times even when they are on the same plane.

Stage II, Sub-stage IIA

Children are able to compare the reciprocal distances between A and B in spite of the interpolated screen but maintain that the overall distance varies with the thickness of Screen, that is, no conservation. At this stage, Ss only infrequently understand the symmetrical property when A and B are on the same horizontal plane, and never when A and B occupy different horizontal planes.

Stage II, Sub-stage IIB

This sub-stage is dichotomized so that Ss may make either Type A or Type B responses.

1. Type A: Non-conservation responses, similar to sub-stage IIA but Ss now acknowledge the symmetry of distance A-B.
2. Type B: Ss make responses which are indicative of an understanding of distance conservation; however, they deny the symmetrical nature of the distance A-B.

Stage III

Children at this stage are distance conservers. That is, they are able to conserve the distance A-B in spite of the interposed screen and also acknowledge the symmetrical nature of the distance between A and B.

Côté and Boersma are critical of the Type B classification since the Piagetian position states that the acquisition of conservation is a function of equilibration, which in itself is a cognitive process which results in the manifestation of operational reversibility and identity, and that both are fundamental to the acquisition of conservation (Piaget and Inhelder, 1941). An operational notion of distance symmetry is clearly a manifestation of reversibility and therefore should precede the acquisition of distance conservation. Wallach et. al. (1967) support this contention with their findings that reversibility and not the use of misleading cues are both necessary for conservation. Engleman (1967) on the other hand concludes in his study that reversibility does not function as a critical difference between conservers and non-conservers. However, in the Type B classification, distance conservation seems to precede the symmetrical understanding of the distance A-B.

A significant difference ($p < .001$) was found between the Piagetian testing procedure (PTP), which places the Sc so that it seemingly bisects distance A-B and the Côté-Boersma testing procedure (CBTP), which places the Sc so that it visibly does not bisect distance A-B. The results of the Côté testing procedure lend excellent support to Piaget's overall theoretical framework but as such deny the existence of the Sub-stage IIB Type B. Postulates and hypotheses arising from a consideration of the preceding theoretical positions are developed in Chapter IV.

The present inquiry is concerned with broader aspects of the conservation problem than those outlined in the preceding pages. Accordingly, the remainder of this chapter considers recent findings regarding the interrelationship of various conservation tasks and concomitant variables such as age, IQ, sex, and SES.

With respect to the relative complexity of various conservation tasks Goldschmid (1967) concludes that the ascending rank order of conservation tasks is as follows: 1. substance, 2. number, 3. continuous quantity, 4. two-dimensional space, 5. discontinuous quantity, 6. weight, 7. area, 8. length, 9. three-dimensional space, and 10. distance. Some question arises regarding the relative order of distance and length conservation since Goldschmid (ibid.) appears to have made his distance conservation task unnecessarily difficult. One test is in line with the typical Piaget distance task as elaborated by Flavell (1963, p. 336). However, the second distance test employed by Goldschmid and again elaborated by Flavell (1963, p. 323) does not conform to the usual Piagetian task. Briefly, the latter test presents Ss with

a segmented and a straight car track. A car is moved on the straight track while Ss are asked to move a second car the same distance as the first car. In this experiment Goldschmid does not appear to heed Piaget's (1960) caution on the study of distance: "It is important to avoid any reference to movement or distance travelled a consideration which applies equally to the study of length (p. 71)." In fact, Flavell (1963, p. 322) classifies Goldschmid's second distance conservation test as being related to concepts of movement and velocity - not distance conservation. In order to conform to Piaget's procedure for distance conservation testing, Goldschmid's second distance task was not included in the present study. The present investigation does not attempt to re-evaluate the rank order of all ten conservation tasks considered by Goldschmid (1967). The present study focuses on the relationship between symmetry, length and distance when the presence of the latter is ascertained by measures consistent with Piagetian procedures. Since the bulk of conservation studies involve the conservation of substance, Ss standing on this dimension were also assessed with the intent of establishing the relative position of this much studied phenomenon in a simple conservation hierarchy.

Studies of conservation concepts generally support Piaget's (Piaget & Inhelder, 1941) contention of age dependent cognitive development while allowing significant individual differences within a given age group (Vinh-Bang, 1957; Elkind, 1961; Smedslund, 1961; Lovell, 1962; Laurendeau & Pinard, 1962; Dodwell, 1962; Dodwell, 1963; Goodnow and Bethon, 1966; Pratoomraj and Johnson, 1966; Goldschmid, 1967). However, the influence of sex differences, IQ and socio-economic status, as the following paragraphs illustrate has not been as clearly

established.

Goldschmid (1967) found that boys obtained consistently higher conservation scores than girls. The majority of studies, however, conclude that sex differences seem to be insignificant as far as conservation is concerned (Braine, 1969; Case, 1962; Dodwell, 1962; Danzinger, 1962; Laurendeau & Pinard, 1962; Uzgiris, 1964; Towler, 1965; Protoomraj and Johnson, 1966).

Goldschmid's (1967) findings indicate that conservation is positively correlated with IQ. Sigel and Mermelstein (1965) also suggest strongly "that variations in intelligence are to be seriously considered in any comparison by way of Piaget's tasks". Furthermore, the studies of Feigenbaum (1963) and Elkind (1961) provide substantiation of Inhelder's (1944) stand that conservation tasks of amount, weight and volume will differentiate between dull children and children about 30 points higher on an IQ scale. However, studies concluding that IQ is an insignificant variable are available. For example, Kooistra (1963) found that IQ accounted for only a small part of the variance in his study of conservation. Cowan (1964) also concluded that higher IQ ratings was not related to the S's ability to solve Piagetian problems.

Research on the effect of socio-economic status (SES) on the acquisition of conservation concepts has not been extensive. The little evidence that is available would suggest that SES should be considered in conservation studies. For example, Smedslund (1959) in studying children from Geneva, found that a superior socio-economic milieu resulted in earlier transition ages at which con-

servation appeared. To further support the notion that SES is a variable to be considered when testing for conservation, Lefrançois (1967) hypothesized that scores of the Blishen Scale (1958) would correlate significantly with success or failure on conservation tasks. Lefrançois (ibid.) concluded that "SER (socio-economic rating) may be a better predictor of success on conservation tasks than MA (ibid., p. 48)".

Piaget does not seem to be overly concerned with the effect of specific environmental variables. However, since the schemata are seen as evolving in contact with environment, it could reasonably be expected that Piaget would not deny the possible effect of SES, IQ, and sex on the attainment of operatory conservation concepts.

A review of the literature has indicated that the results of studies aimed at evaluating those variables are at best inconclusive. The present study was designed in part to clarify those inconclusive findings.

CHAPTER III

METHOD

A. THE SAMPLE

The sample consisted of 96 grade one students (57 males; 39 females) enrolled in two urban elementary schools of the Edmonton Public School System. Their ages ranged from 6.4 years to 7.9 years with a mean of 6.86 years and a standard deviation of .33 years. The Detroit Beginning First Grade Intelligence Test scores, obtained from the school records, were used as an index of mental age (mean 105.85; standard deviation 15.12). Socio-economic status rating was determined by the father's occupation rank (or mother's in the event that the mother supports the family) as determined by the Blishen Occupational Class Scale (Blishen, 1967).

B. OUTLINE OF GENERAL PROCEDURES

All Ss were given five tests of symmetry, three tests of conservation of distance, two tests of conservation of substance and two tests of conservation of length. Specific description of these tests follows. Ss were tested individually by the same examiner. The testing time required for each S was between 10 and 15 minutes. Ss' responses were recorded on a specially designed answer sheet which is reproduced in Appendix D. Appendix B shows the room layout and testing order.

C. SYMMETRY TESTING PROCEDURES

Materials

1. 2 - 3-3/4" x 3/4" round dowels.
2. 1 - 7-1/2" x 1-1/2" round dowel.

Procedures

1. Test 1: The procedure employed was an adaptation of the Piaget, Inhelder and Szeminska technique (1960). The question of symmetry was introduced by showing the Ss two equal-sized figures A-B which were situated about 50 cm. apart. To obtain a protocol, the Ss were asked whether the figures A-B were "near one another" or "far apart". Reference to movement or distance travelled was rigorously avoided.

The Ss were then asked: "Is it as near (or 'far', using Ss' previous formulation) from there to there (A-B) as it is from there to there (B-A)?" The experimenter ran his finger along distances A-B and B-A to avoid misunderstanding.

2. Test 2: Repetition of Test 1 with object B twice as large as object A. Any mention of movement was avoided.
3. Test 3: Repetition of Test 1 with object B raised 50 cm. above object A. Any mention of movement up or down was avoided.
4. Test 4: Repetition of Test 1 with object B twice as large as object A and with object B raised 50 cm. above object A. Any mention of movement was avoided.
5. Test 5: Repetition of Test 1 with object B twice as large as object A and with object A raised 50 cm. Again, any reference of movement

was avoided.

D. DISTANCE CONSERVATION TESTING PROCEDURES

Materials

1. 2 - 4" x 3/4" round dowels.
2. 1 - 6" x 1/" styrofoam screen.
3. 1 - 6" x 10" x 3" styrofoam screen.
4. 1 - Equivalence Distance Measuring instrument as described in Appendix C.

Procedures

In order to determine distance conservation status four procedures were used at various points of testing.

1. Piaget Testing Procedure (PTP): This procedure made use of the typical task as presented by Piaget, Inhelder and Szeminska (1960). That is, two figures, identical in height were set out on a table at an interval of about 50 cm. In order to give Ss some indication of the problem and to determine a protocol of the language to be used, Ss were asked whether the figures were "near one another" or "far apart". Reference to movement or distance travelled was avoided. The figures remained in the same place throughout the experiment. When the Ss replied that they were "near" (or "far apart") the styrofoam screen was placed halfway between them. Ss were then asked whether they are still as "near" (or "far apart") depending on Ss' previous reply. Ss were asked to give a reason for their response.

2. Côté-Boersma Testing Procedure (CBTP): The CBTP was similar to the PTP. However, the screen was placed so that it did not always

bisect the distance A-B. The screen was placed at approximately $1/4$ of the distance A-B. The important point being that the distance A-Screen was obviously not equal to the distance Screen-B.

3. Equivalence Testing Procedure (ETP): In this procedure the Equivalence Distance Measurement Instrument was used (Appendix C). The instrument consists of two distances A-B and B-C. Points A, B, and C can be moved so that the distance A-B and B-C can either be increased or decreased. Distance A-B served as the variable while Distance B-C served as a visible standard. The points A, B, and C were so placed that distance A-B was equal to distance B-C, that is 50 cm. apart. Ss were told that the two distances were equal. Ss were invited to check with a ruler that was exactly 50 cm. long.

Ss were then asked whether the distance A-B was as "near" of "far" apart as B-C. Reference to movement or distance travelled was avoided. Following this, the screen was placed between A-B and Ss were asked whether A-B was still as "near" (or as "far apart") as B-C. Throughout this process the standard B-C remained unchanged and was a visible reference model to Ss. Ss were pressed to give a reason for their reply.

4. Compensation Test Measure (CTM): Using the ETP the nonconserving Ss were asked to change the distance of the standard B-C so that it was as "far apart" (or as "near") as the variable distance A-B which had a $1/2$ " screen interpolated between A and B. The changes effected were recorded. Ss were asked to justify their activities.

This procedure was repeated with the interpolation of a 3" screen.

E. CONSERVATION OF LENGTH TESTING PROCEDURES

Materials

Four 30 cm. strips of different coloured (red, blue, orange and green) cardboard.

Procedures

Two equal-sized straight strips (red and blue) of cardboard were placed in a horizontal position side by side so that their extremities corresponded. Ss were asked: "Is the red piece of cardboard as long as the blue piece of cardboard or is one longer?" Once Ss confirmed their equality the red strip of cardboard was then moved a few inches forward so that its leading edge was to the right of the blue strip. The Ss were then asked: "Are the two pieces of cardboard the same length or is one longer?"

This same procedure was repeated with the orange and green strip.

F. CONSERVATION OF SUBSTANCE TESTING PROCEDURES (continuous quantity)

Materials

1. 2 equal sized beakers (2" in diameter x 2-1/2" in height).
2. 1 tall test tube (1" in diameter x 7-1/2" in height).
3. 1 larger beaker (2-1/2" in diameter x 1-1/2" in height).
4. Coloured water.

Procedures

Coloured water (blue) in two equal sized beakers was presented to Ss. Ss were asked whether these beakers contained the same amount of water. If Ss did not agree to their equality they were encouraged to add some water in order to fill them to the same level. Once the Ss admitted to equality as to the amount of water, then the two tasks

were presented:

1. The water from one container was poured into the thinner but taller test tube. Ss were asked: "Do these two containers have the same amount of water or does one have more water?" Ss were asked to justify their response.

2. After the water had been poured back into the equal sized containers and their equality again agreed upon, the water from one beaker was poured into the thicker container. Ss were again asked: "Do these two containers have the same amount of water or does one have more water?" Ss were asked to justify their response.

CHAPTER IV

THEORETICAL POSTULATES AND HYPOTHESES

The first hypothesis was concerned with Elkind's (1967) contention that identity conservation is a necessary condition for equivalence conservation and as such identity conservation develops prior to equivalence conservation. A specific test of this postulate was provided by the following hypothesis.

Hypothesis 1

Ss who demonstrate an understanding of conservation of distance ascertained by equivalence testing procedures will also demonstrate an understanding of distance conservation ascertained by identity testing procedures.

Côté and Boersma (1969) questioned Piaget's theoretical and procedural basis for identifying Stage II, Sub-stage IIB, Type B at which stage subjects have an understanding of distance conservation without an understanding of symmetry. Accordingly Côté and Boersma (ibid.) postulated that a modification of the PTP would tend to eliminate that questionable stage. Two related hypotheses arise from the contention that PTP results in erroneous classification of Ss with respect to their standing on the distance problem.

Hypothesis 2.1

A significantly greater proportion¹ of Ss will be classified as being distance conservers when the PTP is employed than when the CBTP is employed.

¹ For Rule of Decision, see end of Chapter IV.

Hypothesis 2.2

The use of the CBTP will significantly diminish the responses classified by Piaget as Stage II, Sub-stage IIB, Type B.

The work of Piaget et. al. (1960) suggests that it is possible to observe four discrete stages in the emergence of symmetry. They are:

1. Stage I: Distance is considered asymmetrical when two equal-sized objects are on the same horizontal plane.
2. Stage II: Distance is considered asymmetrical when two objects differing in size are on the same horizontal plane.
3. Stage III: Distance is considered asymmetrical when two objects of the same size are on different horizontal planes.
4. Stage IV: Distance is considered asymmetrical when two objects differing in size are on different horizontal planes.

Since Piaget's symmetry stage theory is not founded on extensive empirical evidence the present study attempted to ascertain whether such an order can in fact be empirically supported. Accordingly, it was postulated that Stage I is subordinate to Stage II which in turn is subordinate to Stage III which is subordinate to Stage IV.

Specific tests of that postulate were provided by the following hypotheses:

Hypothesis 3.1

Ss will acknowledge the symmetrical nature of distance significantly more often in response to Stage I testing tasks than in response to Stages II, III, and IV testing tasks.

Hypothesis 3.2

Ss will acknowledge the symmetrical nature of distance significantly more often in response to Stage II testing tasks than in response to Stages II and IV testing tasks.

Hypothesis 3.3

Ss will acknowledge the symmetrical nature of distance significantly more often in response to Stage III testing task than in response to Stage IV testing task.

The next two hypotheses are concerned with the relative complexity level of all conservation tasks considered by the present study. Of particular concern will be the relative task complexity order of length and distance. Goldschmid (1967) found that the distance conservation task was more complex than the conservation of length task. Since Goldschmid (ibid.) used an unorthodox procedure in testing for the conservation of length his findings are open to question. It was postulated that the conservation of length would present a more difficult task to Ss than distance conservation when distance conservation was established according to Piaget's precepts.

Hypothesis 4.1

A significantly greater proportion of Ss will acknowledge an understanding of distance conservation than length conservation.

Some question still remains regarding the relative acquisition order of various conservations. There is some literature (Piaget & Inhelder, 1941; Piaget, Inhelder & Szeminska, 1960) that contends that conservation abilities might develop in the following domains in the order in which they are listed here: substance, distance, and

length. However, there is a dearth (Goldschmid notwithstanding) of empirical evidence to support that position. H4.2 was designed to establish the existence of a hierarchy where the acquisition of substance conservation preceeds the acquisition of distance conservation which in turn preceeds the acquisition of length conservation.

Hypothesis 4.2

A significantly larger proportion of Ss will acknowledge an understanding of substance conservation than of distance conservation. Furthermore, a larger proportion of Ss will acknowledge an understanding of distance conservation than of length conservation.

The next four hypotheses will deal with the variables of chronological age, sex difference, IQ, and socio-economic status and their relationship to the various conservation tasks. Various equivocal statements have been advanced regarding the relative influence of age (Elkind, 1961; Smedslund, 1961; Lovell, 1962; Laurendeau and Pinard, 1962; Dodwell, 1962; Dodwell, 1963; Goodnow and Bethon, 1966; Pratoomraj and Johnson, 1966; Goldschmid, 1967), IQ (Inhelder, 1944; Elkind, 1961; Feigenbaum, 1963; Sigel and Mermelstein, 1965; Goldschmid, 1967), sex (Braine, 1959; Case, 1962; Dodwell, 1962; Danzinger, 1962; Laurendeau and Pinard, 1967; Uzgiris, 1964; Pratoomraj and Johnson, 1966; Goldschmid, 1967), and SES (Smedslund, 1959; Lefrançois, 1967) on conservation status. Accordingly four general hypotheses relevant to those areas are advanced in the present study. Subjects were divided into two groups for each of the four variables in question. Those Ss whose scores on age, IQ, and SES fell above the mean comprised one group while those Ss whose scores fell below the mean comprised the other group.

It is the thesis of the present study that age, IQ, and SES

exercise some influence on a S's conservation status while sex is considered as having no influential effect.

Hypothesis 5.1

A significantly greater proportion of Ss in the older group will exhibit an understanding of all conservation concepts when compared to Ss comprising the younger group.

Hypothesis 5.2

There will be no significant differences between the proportion of male Ss and female Ss exhibiting an understanding of conservation concepts.

Hypothesis 5.3

An equal proportion of male Ss and female Ss will exhibit an understanding of all conservation concepts.

Hypothesis 5.4

A significantly greater proportion of those Ss having an SES rating above the mean will exhibit an understanding of conservation concepts when compared to those Ss whose SES rating is below the mean.

The final hypothesis attempts to evaluate the nature of Piaget's contention that Ss who do not possess an operational notion of distance conservation judge the distance with the interpolated screen as being shorter than it was prior to the interpolation of the screen. Piaget et. al. (1960) give the following reason:

"... distance is in interval between objects in a given order, but since an interval can only mean empty space, the introduction of the screen reduces that interval because it occupies space equal to its own width! (Piaget, Inhelder & Szeminska, 1960, p. 78)."

A specific test of this postulate follows.

Hypothesis 6

Ss who do not have an operational notion of distance conservation will judge the distance between two points as being shorter when the screen is interpolated than before the interpolation of the screen.

Rule of Decision

Terms such as: "significantly more often", "significantly greater", and "significantly greater proportion" were employed in the present study to signify substantial or important differences.

1. With the variables of sex, age, IQ and SES a finding that one group consistently outperformed another group was deemed to be significant.
2. When the comparison involved differences in methods, such as PTP and CBTP or between distance conservation and length conservation tasks, or between the various tasks of symmetry, then a 25% difference was considered to be a substantial or "significant" difference.

CHAPTER V

THE RESULTS OF THE STUDY

Hypothesis 1

The first hypothesis was concerned with the postulate that an understanding of identity conservation is a necessary condition for an understanding of equivalence conservation. The specific prediction was that Ss who demonstrated an understanding of conservation of distance ascertained by equivalence testing procedures also would demonstrate an understanding of distance conservation ascertained by identity testing procedures. The findings presented in Table 1 indicate that 28 Ss demonstrated an understanding of distance conservation when the equivalence procedure (CBTP) was used and all of those 28 Ss also demonstrated an understanding of distance conservation when the identity procedure (PTP) was employed. Furthermore, no S demonstrated an understanding of distance conservation when an equivalence procedure was employed and then demonstrated an understanding of distance conservation when an identity procedure was employed. These findings lend support to the first hypothesis.

TABLE 1

COMPARISON OF SUBJECTS, POSSESSING A FULL UNDERSTANDING OF SYMMETRY, WHEN TESTED WITH IDENTITY (PTP) AND EQUIVALENCE (ETP) TESTING PROCEDURES (N=47)

		EQUIVALENCE	
		Conservers	Nonconservers
IDENTITY	Conservers	28	4
	Nonconservers	0	15

Hypothesis 2.1

This simply predicted that a significantly greater proportion of Ss would be classified as being distance conservers when the PTP was used than when the CBTP was employed. Table 2 indicates that 32 Ss out of a total of 96 were classified as distance conservers using PTP and 28 Ss were classified as distance conservers using the CBTP. This was not found to be a significant difference.

TABLE 2

COMPARISON OF THE NUMBER OF DISTANCE CONSERVERS USING
THE PTP AND THE CBTP

	PTP	CBTP
Conservers	32	28
Nonconservers	64	68
Total N	96	96

Hypothesis 2.2

H2.2 predicted that the use of the CBTP would significantly diminish the responses classified by Piaget as Stage II, Sub-stage IIB, Type B. Table 3 shows the comparative classification obtained by the employment of PTP and CBTP. Twelve Ss were classified as belonging to Stage II, Sub-stage IIB, Type B when the PTP was used and this number diminished to four when the CBTP was employed. One S classified by the PTP as being at Stage II, Sub-stage IIA was reclassified as being at Stage II, Sub-stage IIB, Type B by the CBTP bringing the total in that stage to five Ss. It should be noted that all of these five Ss indicated that they had an understanding of at least one symmetry task. The results of this study support H2.2.

TABLE 3
COMPARISON OF THE CLASSIFICATION OF
SUBJECTS INTO PIAGET'S STAGES USING
PTP AND CBTP PROCEDURES

STAGES	PTP	CBTP
Stage I	5	5
Stage II, Sub-stage IIA	32	39
Stage II, Sub-stage IIB, Type A	15	19
Stage II, Sub-stage IIB, Type B	12	5
Stage III	32	28
Total N	96	96

Hypotheses 3.1, 3.2, and 3.3

H3.1, H3.2, and H3.3 were concerned with determining the relative complexity and hierarchical order of the four stages of symmetry (Piaget, et. al., 1960). It was hypothesized that an ascending order of difficulty existed and it was therefore predicted that a significantly smaller proportion of Ss would understand the symmetry concept at each successive stage. The results presented in Table 4 indicate that 39% fewer Ss made Stage II responses, 43% fewer Ss made Stage III responses and 46% fewer Ss made Stage IV responses after having made successful Stage I responses. These results support H3.1. No significant differences in complexity levels of hierarchical order such as those hypothesized in H3.2 and H3.3 were found. Ss standing and success on the variables of symmetry, and distance, length and substance conservation is presented in Appendix E.

TABLE 4
COMPARISON OF RELATIVE TASK COMPLEXITY
OF THE FOUR STAGES OF SYMMETRY

	Symmetry	No Symmetry	Total N
Stage I Task	91	5	96
Stage II Task	55	41	96
Stage III Task	51	45	96
Stage IV Task	49	47	96
Stage IVB Task (Reversed order of Stage IV Task)	51	47	96

Hypothesis 4.1

H4.1 predicted that a significantly greater proportion of Ss would indicate an understanding of distance conservation than of length conservation. Table 5 indicates that 32 Ss or 33% of the total sample had an operatory understanding of distance conservation while only 20 Ss or 21% of the total sample representing 38% fewer Ss had an operatory understanding of length conservation. This supports the postulate that length conservation presents a more complex task than distance conservation.

Hypothesis 4.2

H4.2 predicted that a hierarchical nature of task complexity existed and that this hierarchy would have the following ascending order of difficulty: substance, distance, and length. The results indicated in Table 6 support this contention. Fifty-two Ss or 54% demonstrated

an understanding of conservation of substance, 32 Ss 33% demonstrated an understanding of conservation of distance while only 20 Ss or 21% were considered to be conservers of length. The results in Table 6 also indicate that 28 Ss were considered distance conservers when the CBTP was used while 29 Ss were so classified when the ETP was employed.

TABLE 5

COMPARISON OF THE NUMBER OF Ss
CONSERVING DISTANCE USING PTP AND LENGTH

Conservation Task	Conservers	Nonconservers	Total N
Distance	32	64	96
Length	20	76	96

TABLE 6

COMPARISON OF THE NUMBER OF Ss CONSERVING DISTANCE
USING THREE PROCEDURES
(PTP , CBTP AND ETP), LENGTH AND SUBSTANCE

Conservation Task	Conservers	Nonconservers	Total N
Substance	52	44	96
Distance: PTP	32	64	96
CBTP	28	68	96
ETP	29	67	96
Length	20	76	96

Hypothesis 5.1

H5.1 predicted that a significantly greater proportion of Ss in the older group would exhibit an understanding of the conservation concepts when compared to the younger group Ss. The findings in Table 7 indicate a small but consistent superiority of the older group subjects. The difference between the percentage of success of the older group (35.7%) and younger group (24.0%) on the full distance conservation scale (All) was 11.7 percentage points in favour of the older group.

Hypothesis 5.2

H5.2 predicted that a significantly greater proportion of Ss having an IQ score above the mean would exhibit an understanding of the conservation concepts when compared to the Ss having an IQ score below the mean. Table 8 indicates that the prediction was borne out in every case. The smallest observed percentage difference occurred in the Symmetry I task and Substance Conservation task. In the remaining conservation tasks a difference of at least 15 percentage points was observed between the high IQ and low IQ group. The difference between the percentage of success of the high IQ group (38.8%) and low IQ group (15.5%) on the full distance conservation scale (All) was 23.3 percentage points in favour of the high IQ group.

Hypothesis 5.3

H5.3 predicted that there would not be any significant difference in the proportion between male Ss exhibiting an understanding of the conservation concepts and females. The results listed in Table 9 do not clearly support this hypothesis. Considerable percentage differences were found. However, the results were not consistent. A greater proportion of male Ss showed an understanding on all symmetry tasks, PTP and Total distance (All) tasks. On the other hand, a greater proportion of female Ss exhibited an understanding on CBTP, ETP, substance, and length concepts.

TABLE 7

COMPARISON OF OLDER GROUP Ss AND YOUNGER GROUP Ss
ON CONSERVATION TASKS (N=96)

Group	1	2	Symmetry				Distance				S*	L*
			3	4	5	6*	PTP	EBTP	ETP	ALL*		
Older Group N=42	Total	41	25	23	25	23	21	16	16	15	25	10
	%	97.6	59.5	61.9	54.7	59.5	54.4	38.9	38.9	35.7	59.5	23.8
Younger Group N=54	%	92.7	55.0	46.2	48.1	48.1	44.4	31.4	34.3	24.0	53.6	18.5
	Total	50	30	25	26	26	23	17	18	13	29	10
Total	N	91	55	51	49	51	47	33	34	28	54	20

*6 Denotes number of Ss successful on all symmetry tasks.

*All Denotes number of Ss successful on all symmetry tasks
and all distance conservation tasks.

*S Substance

*L Length

TABLE 8

COMPARISON OF HIGH IQ GROUPS AND LOW IQ GROUP
ON CONSERVATION TASKS (N=96)

Group	1	2	3	Symmetry			Distance				S*	L*
				4	5	6*	PTP	CBTP	ETP	ALL*		
High IQ Group N=51	Total	49	34	32	33	30	27	23	22	21	30	15
	%	96.0	66.6	62.7	60.7	64.7	58.8	44.7	43.1	38.8	58.8	29.4
Low IQ Group N=45	%	93.3	46.6	42.2	40.0	40.0	37.5	22.2	26.6	15.5	53.2	11.1
	Total	42	21	19	18	17	17	10	12	7	24	5
Total	N	91	55	51	51	47	44	33	34	28	54	20

*6 Denotes number of Ss successful on all symmetry tasks.

*All Denotes number of Ss successful on all symmetry and
all distance conservation tasks.

*S Substance

*L Length

TABLE 9
COMPARISON OF MALES AND FEMALES
ON CONSERVATION TASKS (N=96)

Group	1	2	Symmetry			Distance					L*		
			3	4	5	6*	PTP	CBTP	ETP	ALL*		S*	
Male N=57	Total	55	36	35	34	34	33	21	17	20	19	20	10
	%	94.7	63.1	61.4	59.6	59.6	57.8	47.3	29.8	35.5	34.5	50.8	17.5
Female N=39	%	92.3	48.6	41.0	38.4	43.5	35.8	43.5	41.0	35.8	23.0	64.1	25.6
	Total	36	19	16	15	17	14	17	16	14	9	25	10
Total	N	91	55	51	49	51	47	44	33	34	28	54	20

*6 Denotes number of Ss successful on all symmetry tasks.

*All Denotes number of Ss successful on all symmetry and
all distance conservation tasks.

*S Substance

*L Length

Hypothesis 5.4

H5.4 predicted that a significantly greater proportion of those Ss having an SES rating above the mean would exhibit an understanding of the conservation concepts when compared to those Ss whose SES rating is below the mean. The results of Table 10 consistently support this hypothesis. The difference between the percentage of success of the high SES group and the low SES group on most tasks approximated 20%.

Hypothesis 6

H6 predicted that Ss who do not have an operational notion of distance conservation would judge the distance between two points as being shorter when a screen is interpolated than prior to the interpolation of the screen. The results listed in Table 11 indicate that the majority of nonconserving subjects consider the distance to be greater. However, since 40.3% consider the distance to be farther, the hypothesis was not supported.

TABLE 11

COMPARISON OF NONCONSERVING DISTANCE Ss JUDGING
THE DISTANCE WITH THE INTERPOLATED SCREEN AS BEING CLOSER OR FARTHER

	N	%
Closer	37	59.7
Farther	25	40.3
Total N	62	100.0

TABLE 10
PERCENTAGE COMPARISON OF HIGH SES GROUP
AND LOW SES GROUP ON CONSERVATION TASKS (N=96)

Group	1	Symmetry					Distance					L*
		2	3	4	5	6*	PTP	CBTP	ETP	ALL*	S*	
High SES Group N=56	Total	55	37	35	33	33	29	24	24	22	37	16
	%	98.0	66.0	62.0	58.9	58.9	51.7	42.8	41.8	39.2	66.0	28.5
Low SES Group N=40	%	90.0	45.0	40.0	40.0	35.0	37.5	22.5	25.0	15.0	42.5	10.0
	Total	36	18	16	16	14	15	9	10	6	17	4
Total		91	55	51	49	47	44	33	34	28	54	20

*6 Denotes number of Ss successful on all symmetry tasks.

*All Denotes number of Ss successful on all symmetry and
all distance conservation tasks.

*S Substance

*L Length

Nonhypothesized Results

Piaget et. al. (1960) contend that the distance between two sites is considered to be shorter by nonconservers when a screen is interpolated. Furthermore, the distance is thought to be shorter by an amount equal to the thickness of the interpolated screen. Accordingly, the Compensation Test Measure (CTM) was given to determine whether Ss considered the distance to be more or less by the amount of the thickness of the interpolated screen. The results of the present study (Appendix A) indicate that Ss do not compensate for the perceived loss or gain of distance in any consistent manner and as such do not support Piaget et. al.'s (1960) contention. It seems clear then that the large majority of Ss who conceive the relationship between two points as being asymmetrical on a given symmetry task will also tend to see the relationship as being asymmetrical on succeeding symmetry tasks.

CHAPTER VI

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

A. SUMMARY

The purpose of the present study was to examine the conservation concepts of substance, length and distance in the light of recent issues raised by Elkind (1967), Goldschmid (1967), and Côté and Boersma (1969). The effects of concomitant variables such as age, sex, IQ, and SES were also considered. Five tests of symmetry, three tests of distance, a compensation measure, two tests of substance and two tests of length were administered to 96 grade one children having a mean age of 6.86 years with a standard deviation of .33 years. Their mean IQ quotient obtained from school records was 105.85, with a standard deviation of 15.12. Ss SES rating was determined by their father's occupation rating on the Blishen Occupational Class Scale (1967). The mean SES score for the sample was 58.45 with a standard deviation of 17.88. In order to ascertain the effects of the variables of age, sex, IQ, and SES on the conservation tasks the sample was divided into two groups for each of the following variables: age, sex, IQ, and SES. The relative success on each of the conservation tests by these groups was compared.

B. SUMMARY OF RESULTS AND CONCLUSIONS

Hypothesis 1

The findings of the present study indicate that an understanding of distance identity conservation precedes an understanding of dis-

tance equivalence conservation. Although this conclusion supports Elkind's (1967) position that identity conservation is a necessary condition for equivalence conservation, the present findings do not in themselves strongly challenge Piaget's rationale for employing equivalence procedures when testing for the presence of identity conservation.

It might have been expected that a significantly greater number of Ss would have made conservation replies to identity testing procedures as opposed to equivalence testing procedures if Elkind's (1967) claims are valid; a fairer test of their validity would involve the use of a broader age range sample.

Hypothesis 2.1 and 2.2

Hypothesis 2.1 was designed to determine whether the employment of the PTP and the CBTP resulted in significant differences in the classification of distance conservers. While four more Ss were classified as distance conservers when PTP rather than CBTP was employed, this difference was not considered to be significant. Of greater importance was the difference observed in the classification of Ss into Stage II, Sub-stage IIB, Type B when PTP and CBTP was employed. Côté and Boersma (1969) noted that the existence of Stage II, Sub-stage IIB, Type B, at which stage Ss had an understanding of distance conservation but not of symmetry, is questionable. It was postulated that the PTP lead to the erroneous classification of Ss. The results indicate that the use of the CBTP leads to a considerable diminishing of the proportional incidence of Ss classified at this stage. However, the CBTP did not result in an elimination of Stage II, Sub-stage IIB, Type B.

The results of hypothesis 2.1 and 2.2 indicate that the CBTP is a more rigorous and perhaps a more accurate procedure than the PTP and as such its employment should strongly be considered when testing for distance conservation.

Hypotheses 3.1, 3.2, and 3.3

Hypotheses 3.1, 3.2, and 3.3 dealt with the relative levels of complexity of various symmetry tasks. Piaget et. al. (1960) alude to four stages of complexity. At Stage I the symmetrical nature between two equal sized objects is only understood when two equal-sized objects are located on the same horizontal plane. At Stage II the symmetrical nature of distance is understood when two objects of different size are located on the same horizontal plane. This stage is followed by Stage III at which stage the symmetrical nature between two equal-sized objects located on different horizontal planes is understood. At the final stage (Stage IV) the symmetrical nature between two objects is understood when objects of different size are located on different horizontal planes. The findings of the present study indicate that there is a significant difference between the tasks of Stage I and the tasks of the other three stages. No significant difference exists between Stage II, III and IV tasks. It would appear that the critical factor in symmetry testing is the difference of size between objects and the difference in the horizontal plane between two objects. The findings of the present study seem to indicate that only two significant stages of symmetry are discernable and an understanding of symmetry can be accurately determined by presenting only two symmetry tasks.

Hypotheses 4.1 and 4.2

Hypotheses 4.1 and 4.2 dealt with relative rank order of difficulty of conservation tasks. It was found that a significantly greater propor-

tion of Ss demonstrated an operational notion of the conservation concept of substance than distance conservation; and that a significantly larger proportion of Ss in turn had an operational notion of the conservation concept of distance than of length. These findings support the contention of this study, namely, that Goldschmid's (1967) findings of the relative order of complexity of length and distance conservation need to be re-evaluated by the employment of more standard Piagetian distance conservation procedures.

Hypothesis 5.1, 5.2, 5.3, and 5.4

Hypothesis 5.1 was concerned with the relationship between age and conservation concepts. The results indicate that the older group scored higher on all conservation tasks. This is in keeping with Piaget's general age dependent theory of cognitive development. While the differences between the older group and the younger group were not large, they nevertheless were consistent. Since the sample of the present study was drawn from a small age range these results take on an even more significant meaning since a wider age range would in all likelihood have produced even greater differences. The findings of the present study lead to the conclusion that age is an important control variable and should not be overlooked in conservation studies. However, the present findings also indicate that there is an overlap between age groups. That is, some Ss at younger age are able to perform as well or better as older children. Age in itself is at best only a descriptive control variable having little explanatory power and the question of which age related variables account for success or lack of success on conservation tasks, remains to be explored.

Hypothesis 5.2 concerned itself with the relationship of various

conservation tasks and their relationship to IQ. The results consistently indicated that the high IQ group was more successful on conservation tasks than the low IQ group. Accordingly, IQ should be a considered variable when studying conservation concepts.

The largest proportional difference of the four concomitant variables under investigation occurred on the SES variable. The high SES group was consistently more successful on all conservation tasks.

It would appear reasonable to conclude from the present findings that the variables of age, IQ, and SES should not be ignored as factors which measurably affect a S's conservation status.

Hypothesis 6

Hypothesis 6 dealt with an investigation of the reason that non-conservers gave when judging the distance between two points. Piaget et. al. (1960) concludes that nonconserving Ss judge the distance between two objects to be less when a screen is interpolated. According to Piaget et. al. (ibid.) only a small proportion of Ss will judge the distance to be greater and then only when they are thinking of movement. The results of this study are at odds with Piaget et. al.'s (ibid.) contention since a large proportion of Ss considered the distance to be greater.

Ss who consider the interpolated distance to be greater would, according to Piaget et. al. (1960), consider the distance conservation task as involving movement. The experience and results of the present study indicated that the avoidance of the allusion to movement appeared

to be impossible with many Ss. The problem of how to avoid any mention of movement is crucial. Its implications are evident in that Ss whose internal frame of reference to the distance conservation problem involves a concept of movement, will quite correctly consider the distance to be greater. Yet, having misunderstood the intent of the task they may well make responses which may be incorrectly classified. That is, Ss who are distance conservers may be classified as non-conservers.

C. FURTHER IMPLICATIONS

The incidence of correct conservation responses mark the end of the period of intuitive thought and signal the beginning of operational thought. Conservation provides the first evidence of the co-ordinated use of the operations such as identity, reversibility, and combinativity which define concrete reasoning and serve as essential elements in the child's future cognitive structure. Any evaluation of the presence of conservation defines the Ss cognitive capabilities and as such hint at the readiness of the Ss to perform and understand certain cognitive problems. The present study provides some suggestions for the design of evaluative procedures which might well alleviate the critical educational problem involved in the assessment of a child's readiness to engage in various types of cognitive activities.

D. SUGGESTIONS FOR FURTHER RESEARCH

1. Since it has been indicated that chronological age, intelligence and SES are significantly related to the development of distance, length and substance conservation, it might be profitable to conduct further research to determine the exact nature of these relationships.
2. The findings of the present study indicate that conservation of

identity is a necessary condition for the conservation of equivalence as far as distance conservation is concerned. Research to determine the status of identity and equivalence in other conservation areas is still needed.

3. Further research on the relationship of symmetry to reversibility might lead to a clearer understanding to the dubious existence of Stage II, Sub-stage IIB, Type B.

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APPENDICES

APPENDIX A

SYMBOLS AND CODE

<u>Variable</u>	<u>Identification</u>	<u>Code</u>
A	Identification number	
B	Chronological Age	
C	I.Q. (from school record)	
D	Sex	1--male 2--female
E	Blishen Scale ratings	
F	School	
G	Teacher	
H	Symmetry--Test 1	1--pass 2--fail
I	Symmetry--Test 2	1--pass 2--fail
J	Symmetry--Test 3	1--pass 2--fail
K	Symmetry--Test 4	1--pass 2--fail
L	Symmetry--Test 5	1--pass 2--fail
M	PTP	1--pass 2--fail
N	CBTP	1--pass 2--fail
O	ETP	1--pass 2--fail
P	CTM (1 cm. screen)	1--distance closer 2--distance farther
Q	CTM (1 cm. screen)--direction and amount of movement (cm.)	+--model moved farther apart - --model moved closer together 0--no movement (conservers)
R	CTM (4 cm. screen)	1--distance closer 2--distance farther

Appendix A (continued)

SYMBOLS AND CODE

Variable	Identification	
S	CTM (4 cm. screen)--direction and amounts of movement (cm.)	+--model moved farther apart - --model moved closer together 0--no movement
T	Substance--Test 1	1--pass 2--fail
U	Substance--Test 2	1--pass 2--fail
V	Length--Test 2	1--pass 2--fail

Note: Subject 25 gave no answer to the five symmetry tasks and was therefore not considered to have an operational notion of symmetry.

APPENDIX A
SUMMARY TABLE OF RAW DATA

A	Variables																			Substance			Length		
	B	C	D	E	F	G	H	Symmetry					Distance					P	Q	R	S	T	U	V	W
								I	J	K	L	M	N	O											
01	6.42	148	2	75.57	2	1	1	1	1	1	1	1	1	1	0	000	0	000	1	1	1	1	1	1	
02	6.75	112	1	75.57	2	1	1	1	1	1	1	1	1	1	0	000	0	000	1	1	1	1	1	1	
03	7.08	116	2	60.81	2	1	1	2	2	2	2	2	2	2	1	+04	1	+05	1	1	1	1	1	1	
04	6.50	107	2	50.00	2	1	1	1	1	1	1	1	1	2	2	-01	2	-03	1	1	1	1	1	1	
05	6.58	123	2	75.57	2	1	1	2	2	2	2	2	2	2	2	-19	2	-17	2	2	2	2	2	2	
06	6.83	116	1	20.00	2	1	1	1	1	1	1	1	1	1	0	000	0	000	2	2	2	2	2	2	
07	7.00	120	2	76.01	2	1	1	2	2	2	2	2	2	2	1	-06	1	-07	1	1	1	1	1	1	
08	6.50	127	1	29.93	2	1	1	2	2	2	2	2	2	2	2	-05	2	-13	2	2	2	2	2	2	
09	6.91	100	1	31.30	2	1	1	1	1	1	1	1	1	2	2	+03	2	+05	1	2	2	2	2	2	
10	6.83	101	1	40.68	2	1	1	2	2	2	2	2	2	2	2	+02	2	+04	2	2	2	2	2	2	
11	6.50	139	2	40.68	2	1	1	1	2	2	2	2	2	2	0	000	0	000	1	1	2	2	2	2	
12	7.17	112	2	50.00	2	1	1	1	1	1	1	1	1	1	0	000	0	000	1	1	2	2	2	2	
13	7.25	119	1	60.07	2	1	1	1	1	1	1	2	2	2	2	-15	2	-15	1	1	1	1	1	1	
14	6.50	126	1	76.01	2	1	1	1	1	1	1	1	1	1	0	000	0	000	1	1	1	1	1	1	
15	6.83	101	1	75.57	2	1	1	2	2	2	2	2	2	2	2	+15	2	+20	2	2	2	2	2	2	
16	6.91	089	1	29.71	2	1	1	2	2	2	2	2	2	2	2	+10	2	+10	2	2	2	2	2	2	
17	7.58	084	2	25.00	2	1	1	2	2	2	2	2	2	2	1	-03	1	-03	1	1	2	2	2	2	
18	6.42	125	1	75.57	2	1	1	1	1	1	1	1	1	1	0	000	0	000	1	1	2	2	2	2	
19	7.42	113	1	54.75	2	1	1	1	1	1	1	2	2	2	2	+08	2	+08	2	2	2	2	2	2	
20	6.66	115	1	76.01	2	1	1	1	1	1	1	2	2	2	2	+06	2	+08	2	2	2	2	2	2	
21	7.25	074	1	74.34	2	1	1	2	2	2	2	2	2	2	1	+22	1	+22	2	2	2	2	2	2	
22	7.08	088	1	31.30	2	1	1	2	2	2	2	2	2	2	1	-02	1	-07	2	2	2	2	2	2	

Appendix A (continued)

SUMMARY TABLE OF RAW DATA

A	B	C	D	E	F	G	H	Variables										Substance			Length	
								Symmetry	Distance	P	Q	R	S	T	U	V	W					
23	6.58	118	2	29.31	2	2	1	2	2	2	2	2	-04	2	2	2	2					
24	7.33	090	2	30.19	2	2	1	2	2	2	-18	2	-18	2	2	2	2					
25	6.66	113	2	39.66	2	0	0	2	2	2	-06	2	-08	2	2	2	2					
26	6.66	086	2	39.54	2	2	2	2	1	0	000	0	000	2	2	2	2					
27	6.75	113	2	37.14	2	2	1	2	2	2	+08	2	+12	2	2	2	2					
28	6.91	119	2	70.14	2	1	1	1	1	0	000	0	000	1	1	2	2					
29	6.66	110	2	70.14	2	1	1	1	1	0	000	0	000	1	1	2	2					
30	6.75	103	2	72.87	2	1	1	1	2	2	+15	2	+08	1	1	2	2					
31	6.66	108	2	45.99	2	1	1	2	2	1	-20	1	-20	1	1	2	2					
32	6.66	108	2	31.30	2	2	2	2	2	1	+08	1	+15	1	1	2	2					
33	6.83	067	1	32.14	2	2	2	2	2	2	-04	2	-07	2	2	2	2					
34	6.75	096	1	75.57	2	2	1	2	2	1	-12	1	-11	1	1	2	2					
35	7.25	122	1	76.01	2	1	1	1	1	0	000	0	000	2	2	2	2					
36	7.25	101	1	25.00	2	2	2	2	2	1	-16	1	-05	1	1	2	2					
37	7.00	067	1	34.63	2	1	1	1	2	1	-04	1	+04	2	2	2	2					
38	7.42	088	1	20.00	2	1	1	2	2	1	-08	1	-04	2	2	2	2					
39	6.58	108	1	70.14	2	2	1	2	2	1	-14	1	-12	1	1	2	2					
40	6.58	091	1	70.94	2	1	1	2	2	2	+04	2	+06	1	1	2	2					
41	6.75	103	1	40.68	2	2	2	2	1	0	000	0	000	2	2	2	2					
42	6.83	112	1	34.75	2	1	1	2	2	1	-12	1	-11	2	2	2	2					
43	6.42	116	1	58.29	2	1	1	1	1	0	000	0	000	1	1	2	2					
44	6.42	096	1	75.49	2	1	1	1	1	0	000	0	000	1	1	1	1					

Appendix A (continued)
SUMMARY TABLE OF RAW DATA

A	B	C	D	E	F	G	H	Variables										Substance			Length	
								Symmetry			Distance				P	Q	R	S	T	U	V	W
								I	J	K	L	M	N	O								
45	6.42	115	1	50.00	2	1	1	1	1	1	1	2	2	2	1	-04	1	-13	2	2	2	2
46	6.91	079	1	48.07	2	2	1	1	1	1	1	1	1	1	0	000	0	000	2	2	1	1
47	7.25	110	1	16.01	2	2	1	1	1	1	1	1	1	1	0	000	0	000	1	1	2	2
48	6.42	091	1	45.05	2	2	1	1	1	1	1	2	2	2	1	-04	1	-08	1	1	2	2
49	7.00	103	1	48.56	2	2	1	1	1	1	1	2	2	2	1	-02	1	-06	1	1	2	2
50	7.17	096	1	76.01	2	2	1	1	1	1	1	2	2	2	2	+04	2	+06	1	1	1	1
51	7.00	103	2	70.14	1	3	1	2	2	2	2	1	2	2	1	-03	1	-03	1	1	2	2
52	6.50	124	2	39.21	1	3	1	2	2	2	2	2	2	2	1	-20	1	-20	1	1	2	2
53	6.91	121	2	73.81	1	3	1	1	1	1	1	1	1	1	0	000	0	000	1	1	1	1
54	6.66	100	2	60.42	1	3	1	1	1	1	1	1	1	1	0	000	0	000	1	1	2	2
55	6.91	092	2	48.74	1	3	1	2	2	2	2	2	2	2	2	+05	2	+08	1	1	2	2
56	7.91	072	2	74.27	1	3	1	2	2	2	2	2	2	2	1	-06	1	-08	1	1	2	2
57	7.17	102	2	75.41	1	3	1	1	1	1	1	1	1	1	0	000	0	000	1	1	1	1
58	7.17	104	2	68.80	1	3	1	2	1	2	2	2	2	2	2	+25	2	+25	1	1	2	2
59	7.25	109	2	75.57	1	3	1	1	1	1	1	1	1	1	0	000	0	000	2	2	2	2
60	6.66	097	2	50.00	1	3	1	1	2	2	2	2	2	2	2	+15	2	+25	1	1	2	2
61	6.66	088	2	62.04	1	3	1	1	1	1	1	1	1	1	0	000	0	000	2	2	2	2
62	7.42	109	1	74.27	1	3	1	1	1	1	1	1	1	1	0	000	0	000	1	1	2	2
63	6.91	101	1	76.01	1	3	1	1	1	1	1	1	1	1	0	000	0	000	1	1	2	2
64	6.50	126	2	76.01	1	3	1	1	1	1	1	2	2	2	1	-21	1	-26	2	2	2	2
65	6.83	102	2	76.01	1	3	1	2	2	2	2	2	2	2	1	-07	1	-10	2	2	2	2
66	6.42	121	1	70.14	1	3	1	1	1	1	1	1	1	1	0	000	0	000	1	1	2	2

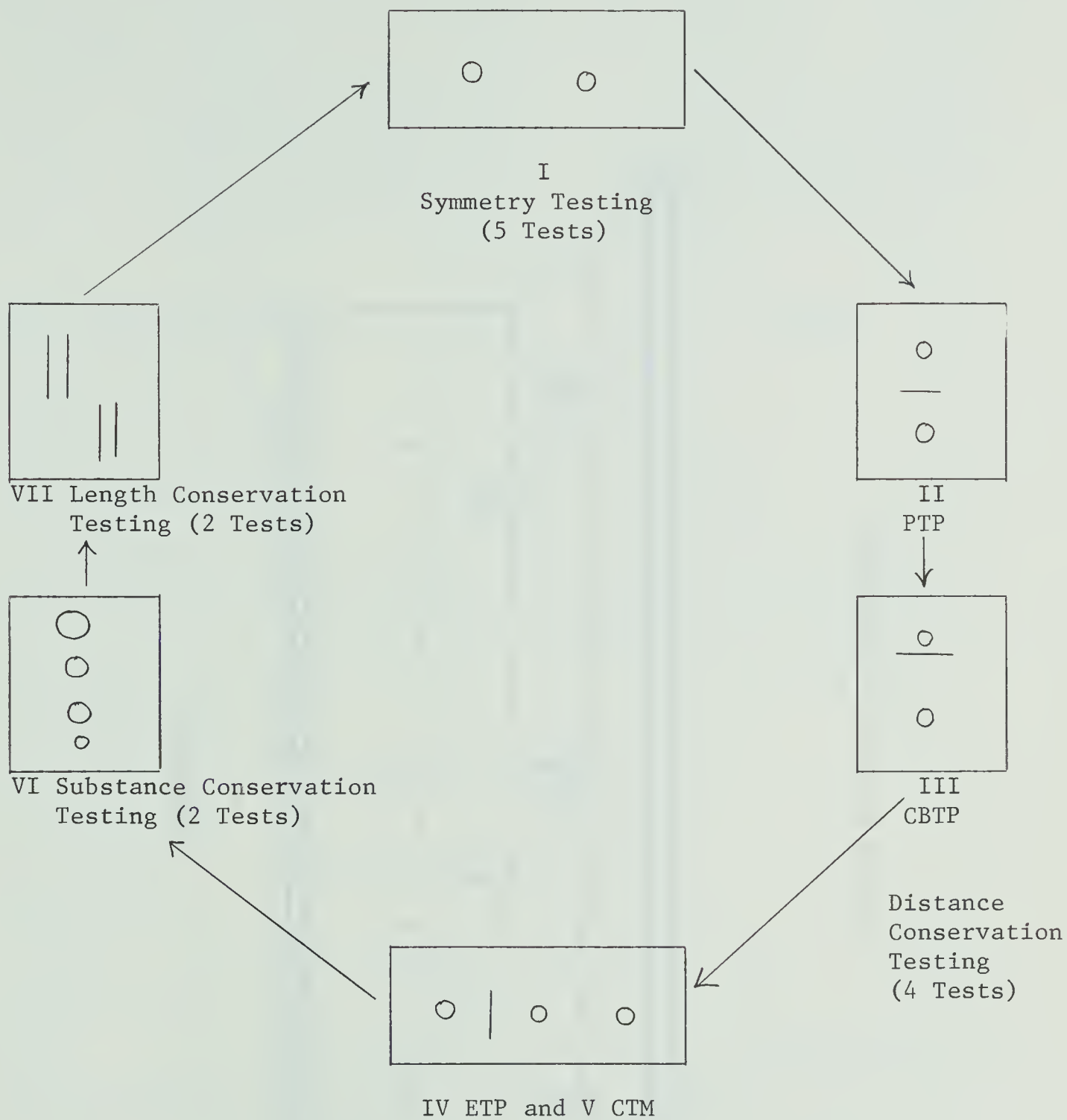
Appendix A (continued)
SUMMARY TABLE OF RAW DATA

	Variables																	Length		
	Symmetry				Distance				Substance				V	W						
A	B	C	D	E	F	G	H	I	J	K	L	M			N	O	P	Q	R	S
67	6.66	089	1	43.69	1	3	1	2	1	1	2	1	2	2	1	-21	1	-21	2	2
68	6.50	109	1	55.19	1	3	1	1	1	1	1	1	1	1	0	000	0	000	2	2
69	7.17	094	1	75.57	1	3	1	1	2	2	2	2	2	2	2	+11	2	+15	1	1
70	6.75	085	1	43.69	1	3	1	2	2	2	2	2	2	2	1	-01	1	-05	2	2
71	6.91	081	1	70.14	1	3	1	1	1	1	1	1	2	2	1	-12	1	-22	2	2
72	6.75	125	1	68.80	1	3	1	2	2	2	2	2	2	2	2	+06	2	+12	2	2
73	6.58	123	2	76.01	1	3	1	2	2	2	2	2	2	2	1	-06	1	-22	2	2
74	7.25	118	1	74.27	1	3	1	1	1	1	1	1	1	1	0	000	0	000	1	2
75	6.58	116	1	70.14	1	3	1	2	2	2	2	2	2	2	2	+05	2	+17	2	2
76	6.83	107	1	75.49	1	3	1	2	2	2	2	2	2	2	1	-08	1	-17	1	2
77	6.42	089	1	55.19	1	3	1	2	2	2	2	2	2	2	1	-26	1	-21	1	2
78	6.50	129	1	76.01	1	3	1	1	1	1	1	1	1	1	0	000	0	000	1	1
79	6.66	119	2	76.69	1	3	1	1	1	1	1	1	1	1	0	000	0	000	1	1
80	6.58	111	2	75.16	1	4	1	1	1	1	1	2	2	2	1	+01	1	+02	1	1
81	7.17	111	1	67.28	1	4	1	1	1	1	1	1	1	1	0	000	0	000	1	1
82	7.58	100	1	70.43	1	4	1	1	2	2	2	2	2	2	1	-04	1	-02	2	2
83	7.17	109	1	44.82	1	4	1	2	2	2	2	2	2	2	1	-20	1	-18	2	2
84	7.17	094	1	62.04	1	4	1	1	1	1	1	1	1	1	0	000	0	000	1	2
85	7.33	122	1	45.52	1	4	1	2	1	2	2	2	2	2	1	-02	1	-04	1	2
86	6.75	109	1	74.27	1	4	1	2	2	2	2	2	2	2	1	-26	1	-21	2	2
87	7.33	097	2	75.41	1	4	1	2	2	2	2	1	1	1	0	000	0	000	1	1
88	6.91	106	1	55.37	1	4	1	1	1	1	1	1	1	1	0	000	0	000	1	2

Appendix A (continued)
SUMMARY TABLE OF RAW DATA

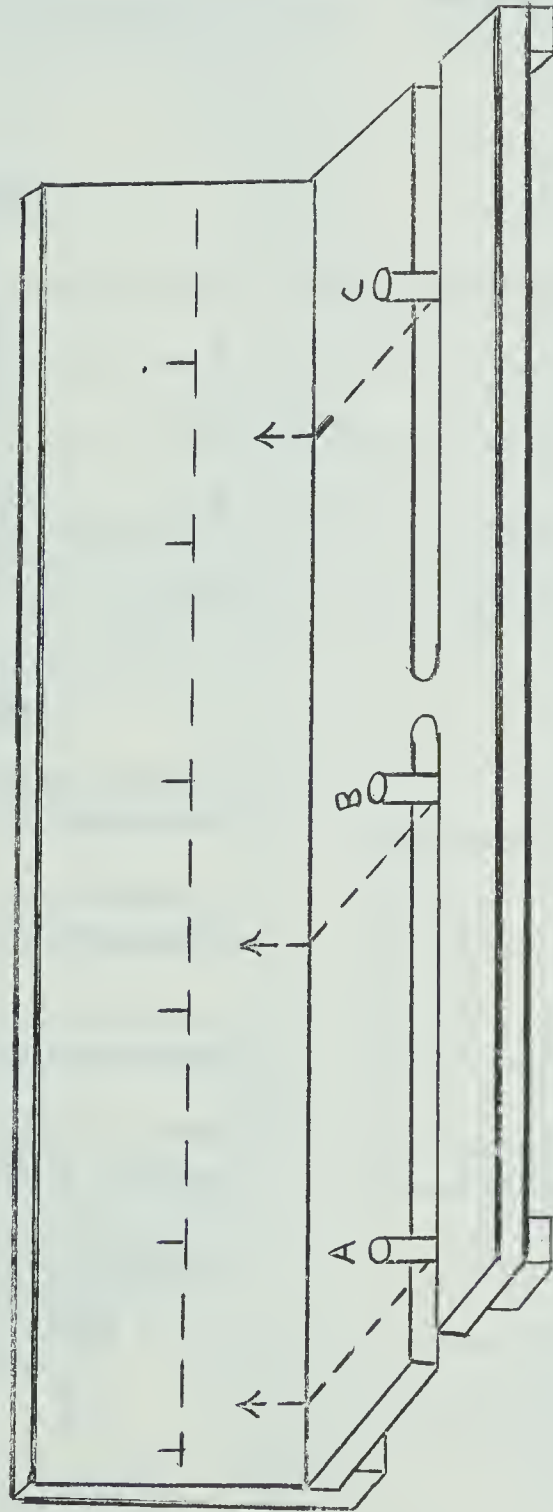
A	Variables																				Length	
	Symmetry								Distance				Substance									
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U		V
89	6.66	099	2	74.77	1	4	1	1	1	1	1	2	2	2	2	+10	2	+12	2	2	2	2
90	6.42	124	2	74.27	1	4	2	2	2	2	2	2	2	2	1	-22	1	-23	2	2	2	2
91	6.66	105	1	72.87	1	4	1	1	1	1	1	2	2	2	1	+04	1	+06	1	1	2	2
92	6.58	097	1	74.27	1	4	1	2	2	2	2	2	2	2	1	-20	1	-24	1	1	2	2
93	6.42	129	2	40.68	1	4	1	2	2	2	2	1	1	1	0	000	0	000	1	1	1	1
94	7.17	112	1	76.01	1	4	1	1	1	1	1	2	2	2	1	-08	1	-11	2	2	2	2
95	7.25	099	2	62.04	1	4	1	2	2	2	2	2	2	2	1	-10	1	-21	2	2	2	2
96	7.08	099	1	66.04	1	4	1	1	1	1	1	1	1	1	0	000	0	000	2	2	2	2

Appendix B



Testing Room Layout and Order of Tests

APPENDIX C



ETP and CTM Testing Apparatus

Appendix D
SCORE SHEET

Name _____ Sex _____ Date _____

Birthdate _____ Age _____ Grade _____

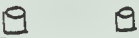
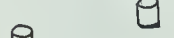
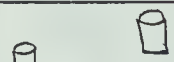
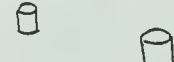
Father's Occupation _____

School _____ Teacher _____

IQ _____

A. Test for Symmetry

Comments

- | | | | |
|-----|---|---------|--|
| (1) |  | () | |
| (2) |  | () | |
| (3) |  | () | |
| (4) |  | () | |
| (5) |  | () | |

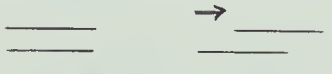
B. Conservation Tasks

- | | | | |
|-----|-------------|----------------------------------|----------------|
| (1) | <u>PTP</u> | (a) Conserve
(b) Nonconserve | _____ |
| (2) | <u>CBTP</u> | (a) Conserve
(b) Nonconserve | _____ |
| (3) | <u>ETP</u> | (a) Conserve
(b) Nonconserve | _____ |
| (4) | <u>CTM</u> | (a) 1/2" Screen
(b) 3" Screen | _____
_____ |

C. Conservation of Substance

- | | | |
|-----|---|-------|
| (1) |  | _____ |
| (2) |  | _____ |

D. Conservation of Length

- | | | |
|-----|---|-------|
| (1) |  | _____ |
| (2) |  | _____ |

SUMMARY OF SYMMETRY, LENGTH AND SUBSTANCE STATUS ACCORDING TO THREE
DISTANCE CONSERVATION TESTING PROCEDURES (PTP, CBTP, ETP)

SYMMETRY DEMONSTRATED ON ALL TASKS

	PTP					CBTP					ETP							
Substance	(+)	3	(-)	0	(+)	5	(-)	7			(+)	3	(-)	1	(+)	5	(-)	10
Length																		
Distance																		
(N)																		
Distance																		
Length																		
Substance	(+)	10	(-)	1	(+)	15	(-)	6			(+)	9	(-)	1	(+)	14	(-)	4

NO SYMMETRY DEMONSTRATED ON ALL TASKS

	PTP					CBTP					ETP							
Substance	(+)	2	(-)	0	(+)	14	(-)	20			(+)	3	(-)	0	(+)	0	(-)	3
Length																		
Distance																		
(N)																		
Distance																		
Length																		
Substance	(+)	3	(-)	1	(+)	9	(-)	8			(+)	3	(-)	1	(+)	15	(-)	24

(+) Conservers
(-) Non-Conservers

SYMMETRY DEMONSTRATED ON TASK 1

	PTP				CBTP				ETP			
Substance	(+) 5	(-) 0	(+) 19	(-) 23	(+) 11	(-) 1	(+) 14	(-) 8	(+) 7	(-) 1	(+) 21	(-) 28
Length	(+) 5		(-) 42		(+) 12		(-) 22		(+) 8		(-) 49	
Distance	(-)		47		(-)		57		(-)		57	
(N)	N = 91				N = 91				N = 91			
Distance	(+) 44				(+) 34				(+) 34			
Length	(+) 15		(-) 29		(+) 12		(-) 22		(+) 12		(-) 22	
Substance	(+) 13	(-) 2	(+) 16	(-) 13	(+) 11	(-) 1	(+) 7	(-) 1	(+) 11	(-) 1	(+) 14	(-) 8

	PTP				CBTP				ETP							
Substance	(+)	0	(-)	0	(+)	1	(-)	4	(+)	0	(-)	0	(+)	0	(-)	1
Length	(+) 0		(-) 5		(+) 0		(-) 5		(+) 0		(-) 0		(+) 1			
Distance	(-)		5		(-)		5		(-)		1		N = 5			
(N)	N = 5				N = 5				N = 5				N = 5			
Distance	(+) 0				(+) 0				(+) 0		4		(+) 4			
Length	(+) 0		(-) 0		(+) 0		(-) 0		(+) 0		(-) 4		(+) 4			
Substance	(+)	0	(-)	0	(+)	0	(-)	0	(+)	0	(-)	0	(+)	0	(-)	3

(+) Conservers
(-) Non-Conservers

SUMMARY OF SYMMETRY, LENGTH AND SUBSTANCE STATUS ACCORDING TO THREE
DISTANCE CONSERVATION TESTING PROCEDURES (PTP, CBTP, ETP)

SYMMETRY DEMONSTRATED ON TASK 2

	PTP				CBTP				ETP			
Substance	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)
Length	4	0	8	9	5	0	9	11	5	0	9	11
Distance	(+) 4				(+) 5				(+) 5			
(N)	(-) 21				(-) 25				(-) 25			
Distance	N = 55				N = 55				N = 55			
Length	(+) 34				(+) 30				(+) 30			
Substance	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)
	10	1	15	8	9	1	14	6	9	1	14	6

NO SYMMETRY DEMONSTRATED ON TASK 2

	PTP				CBTP				ETP			
Substance	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)
Length	1	0	12	18	2	1	13	21	2	1	13	20
Distance	(+) 1				(+) 3				(+) 3			
(N)	(-) 31				(-) 37				(-) 36			
Distance	N = 41				N = 41				N = 41			
Length	(+) 10				(+) 4				(+) 5			
Substance	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)
	3	1	1	5	2	0	0	2	2	0	0	3

(+) Conservers
(-) Non-Conservers

SUMMARY OF SYMMETRY, LENGTH AND SUBSTANCE STATUS ACCORDING TO THREE
DISTANCE CONSERVATION TESTING PROCEDURES (PTP, CBTP, ETP)

SYMMETRY DEMONSTRATED ON TASK 3

	PTP				CBTP				ETP							
Substance	(+)	4	(-)	0	(+)	6	(-)	8	(+)	5	(-)	0	(+)	8	(-)	10
Length			(+)	4	(-)	14					(+)	5	(-)	18		
Distance			(-)		18						(-)		23			
(N)					N = 51								N = 51			
Distance			(+)		33						(+)		28			
Length			(+)	11	(-)	22					(+)	10	(-)	18		
Substance	(+)	10	(-)	1	(+)	15	(-)	7	(+)	9	(-)	1	(+)	13	(-)	5

NO SYMMETRY DEMONSTRATED ON TASK 3

	PTP				CBTP				ETP							
Substance	(+)	1	(-)	0	(+)	14	(-)	19	(+)	2	(-)	1	(+)	14	(-)	21
Length			(+)	1	(-)	33					(+)	3	(-)	35		
Distance			(-)		34						(-)		28			
(N)					N = 45								N = 45			
Distance			(+)		11						(+)		7			
Length			(+)	4	(-)	7					(+)	2	(-)	5		
Substance	(+)	3	(-)	1	(+)	1	(-)	6	(+)	2	(-)	0	(+)	1	(-)	4

(+) Conservers
(-) Non-Conservers

SUMMARY OF SYMMETRY, LENGTH AND SUBSTANCE STATUS ACCORDING TO THREE
DISTANCE CONSERVATION TESTING PROCEDURES (PTP, CBTP, ETP)

SYMMETRY DEMONSTRATED ON TASK 4

	PTP					CBTP					ETP							
Substance	(+)	3	(-)	0	(+)	5	(-)	8			(+)	4	(-)	0	(+)	7	(-)	10
Length			(+)	3	(-)	13						(+)	4	(-)	17			
Distance			(-)	16								(-)	21					
(N)				N = 49									N = 49					
Distance			(+)	33								(+)	28					
Length			(+)	11	(-)	22						(+)	10	(-)	18			
Substance	(+)	10	(-)	1	(+)	15	(-)	7			(+)	9	(-)	1	(+)	13	(-)	5

NO SYMMETRY DEMONSTRATED ON TASK 4

	PTP					CBTP					ETP							
Substance	(+)	2	(-)	0	(+)	15	(-)	19			(+)	3	(-)	1	(+)	15	(-)	21
Length			(+)	2	(-)	34						(+)	4	(-)	36			
Distance			(-)	36								(-)	40					
(N)				N = 47									N = 47					
Distance			(+)	11								(+)	7					
Length			(+)	4	(-)	7						(+)	2	(-)	5			
Substance	(+)	3	(-)	1	(+)	1	(-)	6			(+)	2	(-)	0	(+)	1	(-)	4

(+) Conservers
(-) Non-Conservers

SUMMARY OF SYMMETRY, LENGTH AND SUBSTANCE STATUS ACCORDING TO THREE
DISTANCE CONSERVATION TESTING PROCEDURES (PTP, CBTP, ETP)

SYMMETRY DEMONSTRATED ON TASK 5

	PTP				CBTP				ETP							
Substance	(+)	4	(-)	0	(+)	7	(-)	8	(+)	5	(-)	0	(+)	8	(-)	9
Length			(+)	4	(-)	15					(+)	5	(-)	17		
Distance			(-)		19						(-)		22			
(N)					N = 51								N = 51			
Distance			(+)		32						(+)		29			
Length			(+)	11	(-)	21					(+)	10	(-)	19		
Substance	(+)	10	(-)	1	(+)	15	(-)	6	(+)	9	(-)	1	(+)	14	(-)	5

NO SYMMETRY DEMONSTRATED ON TASK 5

	PTP				CBTP				ETP							
Substance	(+)	1	(-)	0	(+)	13	(-)	19	(+)	2	(-)	1	(+)	14	(-)	22
Length			(+)	1	(-)	32					(+)	3	(-)	36		
Distance			(-)		33						(-)		39			
(N)					N = 45								N = 45			
Distance			(+)		12						(+)		6			
Length			(+)	4	(-)	8					(+)	2	(-)	4		
Substance	(+)	3	(-)	1	(+)	1	(-)	7	(+)	2	(-)	0	(+)	0	(-)	4

(+) Conservers
(-) Non-Conservers

APPENDIX F

CONCEPTION OF SYMMETRICAL DISTANCE AB BY Ss
 NOT HAVING A FULL SYMMETRY UNDERSTANDING

Distance Seen As Being Farther	Symmetry Tasks			
	II	III	IV	V
Going Up	38	42	43	39
Going Down	3	3	4	6
Total N	41	45	47	45

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